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ECE 385 Project Proposal - PetHealth: A Pet Health Monitor

Introduction

Problem

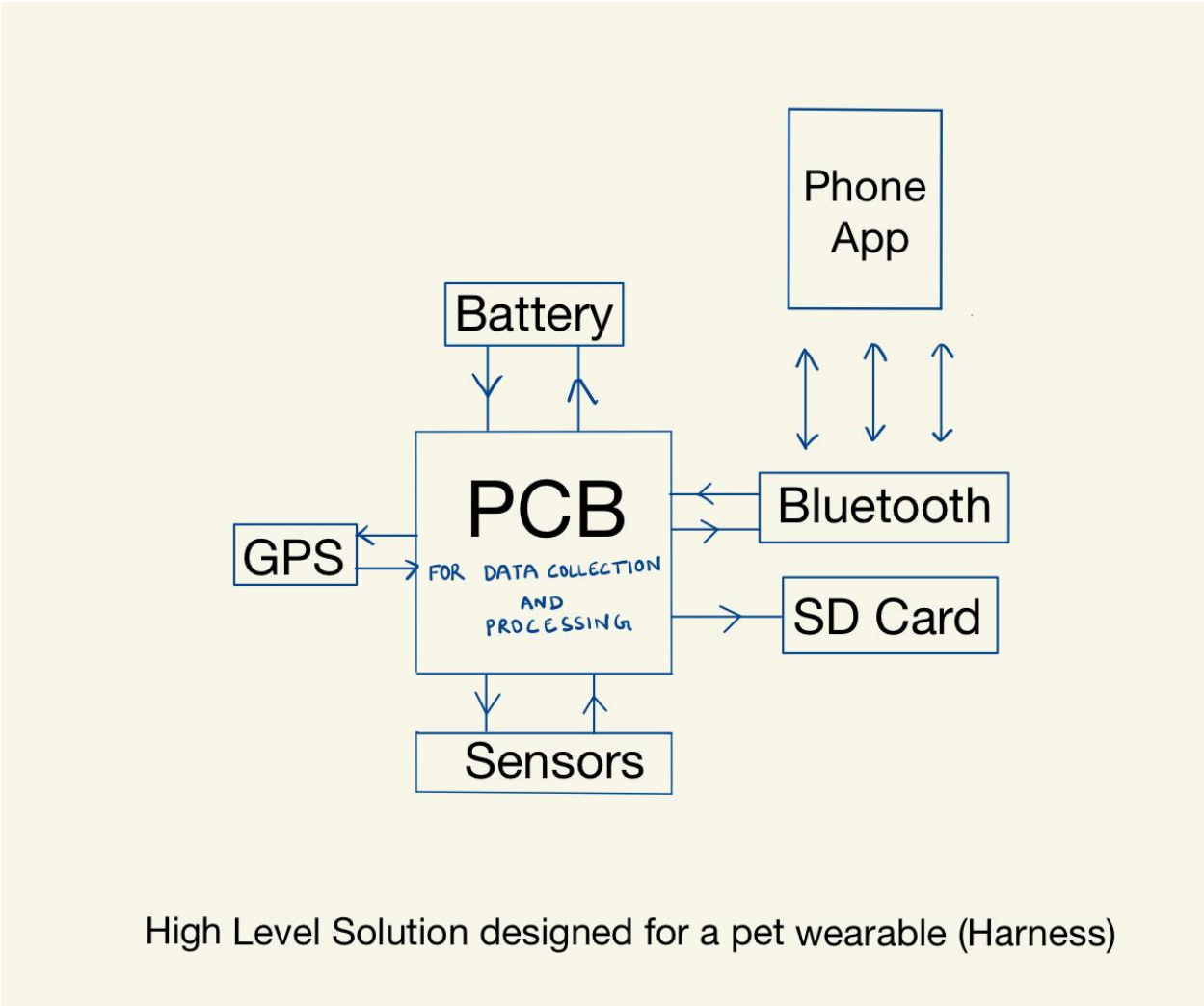
A pet owner's prime concern is the well being of their pets even though the trip to a veterinary doctor is usually very expensive. According to various pet care blogs the average cost of a routine check up can end up anywhere between $50 - $250 depending on the pet, tests required and the doctor's medical opinion. A short term hospitalization can cost anywhere between $600 - $1700. In order to prevent a serious complication, it is very important to monitor the overall health of one's pets.

To avoid incurring the various high costs associated with the different tests for their pets, they can keep a track of these metrics themselves. Metrics like body temperature, fluctuations in body temperature, heart rate, etc can help pet owners keep track of their pet's health and owners can act accordingly to seek medical help. Seeking help at the right moment can save a life while reducing costs associated with further possible complications due to a late diagnosis. Getting separate devices to keep a track of these metrics can be expensive and can miss important information relevant to the health of the pet and an easily affordable integrated solution with real time data collection is yet not available in the market.

Solution

To reduce the costs and inconvenience associated with tracking one's pet's health can be reduced by an integrated solution to monitor their pet's health and collect, store and provide real time relevant information to the owners at a more affordable cost. We propose to implement a size adjustable wearable for pets that can be worn by cats as well as dogs equipped with various sensors to collect real time readings like body temperature and heart rate and a PCB to process that data and store it in an SD card. The collected data would then be transmitted via Bluetooth to the phones of the pet owners.

We also plan to equip our PCB with a GPS to track the location of the pet. Since GPS fails to capture small fluctuations in locations as well as sometimes does not work indoors, the PCB will also be equipped with an accelerometer to collect data relevant to small fluctuations in position. This will help the owners to prevent pets from getting away or even to find them when they are hiding! The collected data, then will be processed to calculate fluctuations in body temperature, hours spent sleeping, calories burnt, etc. The



High Level Solution designed for a pet wearable (Harness)

data collected by the accelerometer will be used to find the displacement in order to find the location of the pet. After collecting and calculating all the relevant data, meaningful results will be generated for the users which they can access using phone applications.

High Level Requirements

1) Sensor Integration & Data Collection

We aim to collect relevant health related data such as body temperature, pulse rate, etc. and process the data to provide meaningful information to the user. A fully functioning product should have all sensors integrated in the harness to maximize sensor capabilities while keeping the comfort of a pet in mind. Our product should be able to collect real-time data and process it to produce meaningful results and be able to transmit the results to the user.

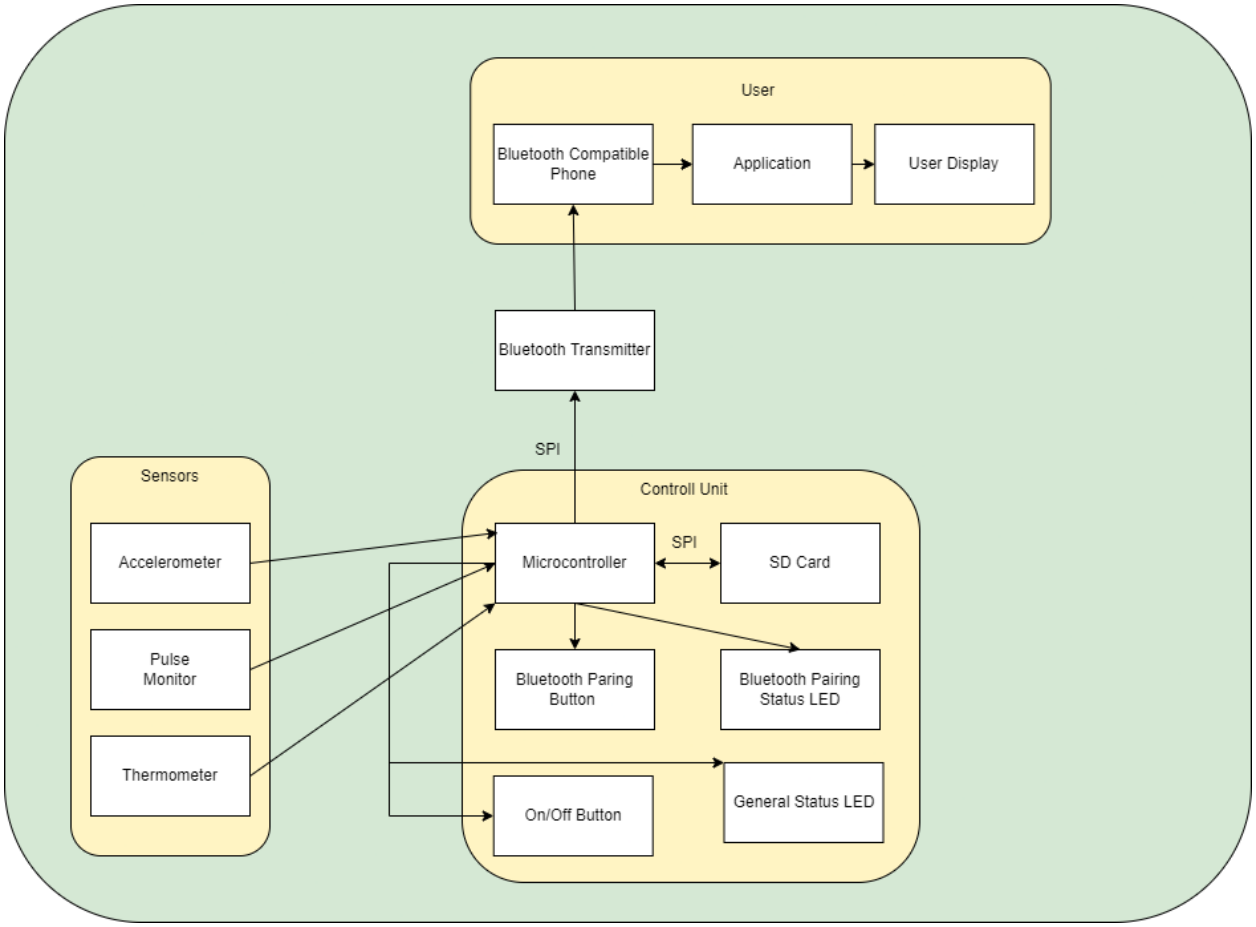
2) Data Storage and Transmission

We aim to be able to store data tracked during a session of use in an SD-Card, and maintain a control unit that decides when to send the data to the user end. When the devices are paired, our control unit will send the packaged data via Bluetooth to the phone, where most of our data analysis and processing is done

3) User End

The end goal is to make the collected data and computed results available to the pet owner in a meaningful way. We aim to use Bluetooth to transmit the data to the user's phones which they can access through a User Interface. The finished version of our project should be equipped with a functioning Bluetooth module which should transmit the data to the phone. A user-friendly UI should display meaningful data and computed results such as the location, body temperature fluctuations, pulse rate fluctuations, sleeping times, etc.

Block Diagram



User End Subsystem

This block includes some kind of smartphone with an application we design to run on top of it. The smartphone will connect with the bluetooth unit via bluetooth. It will download the data available from the sd card, to have the last 24 hours visible at one time. Here the accelerometer data will be used to calculate how far the animal has traveled, and other fun statistics. The temperature and pulse monitor data will be compared with what is within a healthy range for that animal, and will alert the user via a screen prompt or an alert if it is outside that range.
Requirement 1: The phone is able to connect with the bluetooth unit.
Requirement 2: The phone is able to download the last 24 hours of sensor data into the app
Requirement 3: The App can parse and clean the data to give the user the distance statistics, top speed, sedentary time, and check the temperature and pulse monitor to make sure they are within a healthy range.

Bluetooth Transmitter Unit

This block will include a bluetooth chip. It will interface with the controller in order for it to be successfully paired with the phone and then fed the data to pass to the smartphone.
Requirement 1: The bluetooth unit is able to connect with the phone.
Requirement 2: The bluetooth unit is able to transmit the last 24 hours of data to the phone that it is receiving from the controller.

Sensors Unit

This unit includes all the sensors to capture data from the animal that the user would be interested in. This includes an accelerometer which will record all the movement the animal makes. If this works correctly the control unit will receive accurate input on when, how fast, and for how long an animal is moving. The next sensor is the Pulse Monitor, which will record the animal's pulse through its hind leg. If this sensor works properly, it should give the pulse rate of the animal over a period to the control unit. The final sensor is a Thermometer which records the temperature of the animal on some part of their body. If it works properly it should pass a temperate reading to the control unit over the entire period.
Requirement 1: All sensors pass data to the control unit properly
Requirement 2: The data being passed is accurate to around 20% of expected values. For example the temperature sensor will not return the core temperature but will return a temperature wherein the core temperature can be extrapolated from that.

Control Unit

This unit consists of our microcontroller that controls state, the SD-card module and controls for bluetooth. The major states are bluetooth on/off, bluetooth pairing state, device state, data write and read. The bluetooth buttons and lights give us an indication of the state of the bluetooth pairing. The SD-Card module is written to during a session and the data from all sensors is then transmitted to the user-end. It is connected to the microcontroller via SPI Protocol.
Requirement 1: Device on/off states are represented correctly with lights
Requirement 2: Bluetooth pairing is functional and is indicated by lights
Requirement 3: Data is written to the SD Card and can be read and sent to the bluetooth transmitter unit.

Risk Analysis

We have identified the Sensors Unit to be the most difficult to implement. This is because there are inherent problems with measuring pulse and temperature on an animal with as much fur as a cat or dog. Many, if not all of the sensors we would want to purchase are designed for humans, so using them on a cat to great accuracy might be difficult. In the case of the temperature sensor specifically, we only need to find the surface temperature or the inner ear temperature of the animal, and the actual core temperature can be extrapolated. The pulse monitor may be trickier to pin down. The pulse of a cat or a dog can be felt very clearly in the

chest and the hind leg where a large artery lies. We are confident we can get accurate results, and fortunately the allowable range is large. Nobody really cares what the exact pulse of their animal is, only that there is a pulse and that the animal isn't going tachycardic, which we are very confident our sensor will pick up. Given a normal pulse for a cat is 140-220, our pulse monitor can realistically be as much as 25% off in either direction and the cat should still be in range, or near in range.

Ethical Considerations and Safety

Since our project is a product for animals, we must ensure their safety in the usage of the device. We will make efforts to ensure that the harness is comfortable and wearable, while taking into account that even during the testing phases there can be no harm to animals. Additionally, cats are estimated to be able to carry 2-5 kilograms(Tuxedo Cat) without issue, so 2 kilograms serves as a safe upper bound on the total weight of our harness.The Animal Welfare Act bans the use of electronic devices on animals which can stun or potentially harm an animal in any way. We need to be careful about insulating our circuits completely to eliminate accidental shocks. We also need to comply with the various articles mentioned in the 'Humane Care for Animals Act' in deciding the design of the harness and placement of the sensors. Furthermore, The FDA only requires post marketing approval for electronic products intended for animals. Additionally, for our own safety during the designing process, we would take precautions while soldering. Other aspects of our project involve little to no risk to us.

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